excellently with the rule in the section of the Polychætæ, and would form an exception if we referred the *Capitellaceæ* to the Oligochætæ; this applies also to the absence of the vascular system, and to the form of the bristles and their insertion in ridges.

With regard to the distinctions between *Dasybranchus* and *Notomastus* indicated by Sars in addition to the occurrence and want of branchiæ, I will only remark that, in well-preserved small spirit specimens of *Dasybranchus caducus*, the two-ringed nature of the segments is very distinct, and the proboscis of such a specimen appears not so much scaly as covered with papillæ.

XLIII.—*Remarks on the Vessels of the Latex, the Vasa propria, and the Receptacles of the elaborated Juices of Plants.* By M. Lestiboudois*.

The older botanists looked upon the coloured fluids in vegetable organisms as peculiar to certain plants, and called them "proper juices." The vessels containing these juices they, moreover, named "proper vessels," and the plants in which such secretions were recognized, laticiferous or lactescent plants.

Besides coloured liquids, other juices, of a completely distinct character, occur in plants, such as gum, resin, oil, &c. Grew termed the receptacles of resinous fluid in the Coniferæ "turpentine-vessels," and those that contained a milky or white fluid "milk-vessels." Linck designated all such organs by the name of "reservoirs of special secretion." Mirbel gave the title of "proper vessels" to all receptacles of special secretion, whether milky, resinous, or oily, calling those "solitary" which were scattered throughout the tissues, and those "fascicular" which were aggregated together. In this latter category he placed the textile fibres of *Asclepias*, of Hemp, &c., although such structures were destitute of laticiferous juices and were, in fact, nothing more than the cortical fibres of those plants.

DeCandolle, whilst recognizing the heterogeneous nature of special secretions, at first regarded them as the nutritive juices of the plants, but subsequently abandoned this opinion (Organographie, 1827), and ranged all coloured fluids among secreted products, or those prepared by vesicular glands, and thus established a distinction between them and the juices occupying the lacunæ of the cellular tissue. These latter cavities he agreed with Linck in calling "reservoirs of proper secretion." In his 'Physiologie végétale,' published afterwards in 1832, although

* Translated by Dr. Arlidge from the 'Comptes Rendus' for March 1863.

then acquainted with the earlier researches of M. Schultz, he adhered to the opinion that the laticiferous juices are of the nature of secretions.

M. Schultz specially studied the proper vessels of plants, and enunciated various striking discoveries. He advanced the opinion that the coloured juices of plants were no other than the nutritive fluid; that this fluid is coagulable, and characterized by the presence of granules floating in a transparent liquid; that it circulates in thin, transparent, contractile vessels, without pores or fissures, which ramify and anastomose together. The nutritive fluid he called the *latex,* its containing vessels *laticiferous* vessels, and its circulatory movement *cyclosis.* This movement he attributes to the contractility of the walls of the vessels, and to the properties of attraction and repulsion subsisting between the granules and the walls of the vessels. The movement of attraction he terms *autosyncrisis,* and that of repulsion *autodiacrisis.* Such plants as have no coloured sap have, he believes, a latex analogous to that found in laticiferous ones, differing only in its not possessing colouring granules. Moreover, he represents the laticiferous vessels as occurring in a state of *expansion* when they are dilated and filled with granules, in a state of *contraction* when they exhibit only a fine-granular streak, and in a state of *articulation* when they are gorged with juices, but are divided, in consequence of advancing age, into sections by complete septa.

According to these views, plants possess a fluid analogous to blood, and a circulatory apparatus resembling the vascular system of animals.

The statements of M. Schultz produced a great sensation at the time of their publication among botanists, by many of whom they were accepted as true. However, his hypothesis was very soon keenly attacked, and its foundations disputed, by Mohl, Meyer, Treviranus, and others. Mohl denied the existence of the molecular movements of the globules of the latex (the autosyncrisis and autodiacrisis), and also the phenomenon of cyclosis. According to him, any onward movement that may be observed in the liquid within the proper vessels of a plant is not a normal condition, but a consequence of a wound or section of the tissues permitting an escape of their fluid, or else of pressure, of heat, &c., whereby the liquid is driven from one vascular ramification into another. Lastly, the very existence of *vasa propria* has been denied, and the structures so called have been asserted to be merely passages or channels which, as a secondary phase of growth, acquire distinct walls; at the same time, the analogy of the latex with the blood of animals has been disowned; and these various objections have induced many botanists, who at first accepted Schultz's views, to abandon them more or less completely.

Thus Adrien de Jussieu entirely accepted M. Schultz's views in the first edition of his 'Cours élémentaire,' but in the fifth edition of that work omitted the description of laticiferous vessels, referring to the channels so called by Schultz as lacunæ or intercellular spaces which, as an effect of age, ultimately acquired a special wall. He also no longer recognized cyclosis, nor the nutritive nature of the coloured juices. M. A. Richard has likewise ceased to adopt Schultz's opinions, and, instead of recognizing an analogy between the special juices of plants contained in vessels and the blood of animals, concludes that those juices are rather of an excrementitious nature, more akin to bile or saliva, or fluids which are only indirectly concerned in nutrition. "The proper juices are not," he writes (Elémens de Botanique, 7ième édition, p. 253), "the same with the descending sap."

M. Lestiboudois would endeavour to dispel the obscurity and doubt which thus prevail respecting the existence and nature of latex and laticiferous vessels. He wishes to determine whether plants have a special vascular system for the circulation of a fluid analogous to the blood of animals, or, in other words, whether there is such a generally diffused nutritive fluid, called latex, distributed to all the organs of a plant by a system of vessels termed laticiferous vessels. With this object in view, he proposes to study the question first in the case of plants furnished with coloured juices, which have more particularly been compared by analogy with blood, and next in respect to plants with limpid juices; and he advances the following propositions for solution :—

1. Are the coloured juices of plants analogous to blood?

2. Are such juices distributed through the medium of vessels, as in the vascular system of animals?

3. Are such juices gifted with the movement of cyclosis?

4. Are they met with in other reservoirs besides vessels?

5. Can the coloured juices in different reservoirs be distinguished from one another?

6. Are vessels of a similar character discoverable in the generality of non-lactescent plants?

7. In non-lactescent plants are reservoirs found analogous to the non-vascular reservoirs of coloured fluids?

8. Is there an organic apparatus in plants of a more general character than that which encloses coloured juices, and which may be considered to be intended to transport the nutritive sap?

Beginning with the first question, respecting the analogy of the coloured fluids of plants with blood, he remarks that such fluids contain globules, that they coagulate by rest, and that in these particulars they consequently present some features in common with blood. Yet though the coloured liquids become inspissated, they do not present the phenomena of blood-coagulation; for in this latter the fibrinous portion coagulates in a solid mass containing the globules to form the clot, the other portion remaining liquid in the form of serum; whilst in the case of coloured vegetable juices, the globules are aggregated together in a thick mass, and the liquid portion evaporates. In blood, again, the globules have a determinate form and a special organization; while in the proper juices of plants they are often irregular in form, without organization, and of very varied composition. The composition of blood is in harmony with that of the tissues of animals; it contains their elements: on the contrary, no such analogy subsists between the proper juices of plants (the composition of which is very varied and complex) and the fundamental tissue of plants, constituted of cellulose. Lastly, the proper juices are not found at every part, and indeed are generally absent from young tissues, in which the process of growth principally proceeds.

Therefore it may be said that the coloured juices of plants neither resemble a fluid which has to furnish organs with the materials of growth, in their physical properties, in their composition, or in the situations in which they are found.

In the next place, are the vessels in which the proper juices are contained analogous to blood-vessels? Now, it must be admitted that, in certain lactescent plants, these fluids are contained in ramifying and anastomosing vessels having simple translucid walls without pores or fissures, just as Schultz has represented them. To see such vessels, this observer recommended the examination of the stipules of *Ficus elastica*, the epidermis of which is very readily detached from the subjacent tissue. On placing a portion of the tissue so prepared under the microscope, the network of laticiferous vessels is at once seen. If, again, of a large number of lactescent plants portions be boiled, the vessels containing the coloured juices are readily displayed, because the granules of those fluids are coagulated into a more or less compact and continuous mass, filling the tubes and rendering them very visible. By maceration for a longer or shorter time, the surrounding cellular tissue becomes broken up, and the ramifying tubules or vessels are left isolated and open to the ready examination of their characters. Such preparations may be made from the leaves, stems, or roots of the plants, and among others from those of *Campanula Medium*, *C. pyramidalis*, *C. rapunculoïdes*, *Euphorbia sylvestris*, *E. Lathyris*, *Cichorium Intybus*, *Lactuca sativa*, *Papaver somniferum*, *Ascle-*

pias syriaca, Ficus elastica, Broussonetia papyrifera, and *Chelidonium majus.*

In these plants, the reservoirs of the coloured juices clearly constitute a vascular system such as one is accustomed to conceive; there are tubes of more or less tenuity, frequently isolated, though sometimes aggregated in bundles, which anastomose and reunite to form larger trunks, are often flexuose, with thin transparent walls, not lined by a lamina pierced by fissures or pores, and without trace of a cellular organization. They further contain a coloured fluid, varied in appearance by a multitude of small granules held in suspension—these granules being at times comparatively few, but at others so numerous as to render the tubules altogether opake. After the granular liquid is condensed by boiling, the granular matter is either uniformly diffused through the tubes or agglomerated in irregular masses. The tubules readily break across, and the disunited fragments either remain in contact, giving rise to the semblance of an articulation, or become detached and leave a thread of the coagulated liquid they contained stretching between them as an extensible connecting link.

In leaves, these *vasa propria* are generally situated externally to the bundles of cortical fibres and spiral vessels; and they are also met with alongside these bundles, either above or beneath them, as, for example, in *Ficus* and *Asclepias.*

Their arrangement may be readily examined in *Asclepias,* for instance, by preparing the leaves in the following manner:—After boiling them and leaving them to macerate for some days, the epidermis is removed from the veins on the under surface, and the transparent fibrous tissue situated beneath the spiral vessels is then to be separated. On placing a small portion of that tissue under the microscope, the *vasa propria* are readily distinguishable in the form of opake wavy and branching vessels, whilst the neighbouring fibrous tissue is seen to be formed of transparent, very slender, straight, simple tubes with more or less acute extremities, either empty or occupied with more or fewer granules.

The ramifications of the proper vessels are so disposed that the several branches follow the plan of venation of the leaf; some of them, however, are given off in advance of the venous branches, and have rather the appearance of collateral vessels than of ramifications of the *vasa propria.* Sometimes, again, vessels which have been given off in company with a branch in the system of venation send back a recurrent branch, which retraces its course towards the original point of departure of the vessel—a fact, like the two former, also illustrated in the structure of the leaves of *Asclepias.*

The remotest venules are accompanied by fine vascular branches; for in the course of division the latter become more and more attenuated. This circumstance is observable in *Ficus* and *Chelidonium.*

The *vasa propria* of stems appertain especially to the cortical system. Thus, in *Papaver* and *Lactuca,* the special juices are seen, on section, not to flow from the central medulla; or if they do so at all, it is only in very minute quantity. Nevertheless in some other plants, as *Campanulæ* and *Chelidonium majus,* very many such special vessels occur in the woody lamina; and there are plants, indeed, in which such structures are more abundant in the medulla than in the cortical zones; among such is *Asclepias syriaca.* The vessels of stems may be detached in considerable numbers, and isolated by maceration after previous boiling. The proper vessels of the cortex are distributed in the different tissues of its layers: thus, in *Campanula* they are diffused in the parenchyma and in the fibrous layer of the bark; in *Chelidonium* they lie outside the fibrous bundles. The *vasa propria* of stems are generally but slightly ramified, though not, indeed, devoid of frequent divisions. In *Asclepias* these vessels anastomose at every node, in such a manner, too, as to form a plexus and a kind of septum in the medulla. Some of the branches emanating from this plexus are continued to the petiole of the leaf at its junction with a node, and to the young branch which springs from its axil; in this way they traverse the medullary space left between the bundles of woody fibre, and anastomose with the *vasa propria* of the bark, thus establishing a communication between the vascular network of the medulla and that of the cortical system.

The proper juices are in general more dense and of a deeper colour in the lower and older parts of a plant. In young shoots they are pale, and not thick; towards the base of the stem they are habitually much more intense in colour. Thus, in *Asclepias syriaca,* the juices, which are of a pure white colour in the upper portions of the plant, are of a yellow colour near the base of its stem. In *Chelidonium* the juices at the extremities of the branches are of a very pale yellow, but of a deep yellow tint in the main stem, and a reddish yellow in the root.

These dispositions are reversed, however, in certain species: in *Papaver* the proper juices are of a milky-white colour and well marked in the capsules, though scarcely opaline in the root. The proper juices of this plant seem to be derived principally from the fruit, which gives off a white juice on incision in great abundance: yet if the petiole be cut, little exudes; and if the incision be low down in the stem, no escape at all will probably take place.

In other plants where the juices are more coloured and denser in their lower portions, they are there less abundant: thus, for example, in *Chelidonium*, sections of the root are followed by a very small discharge of laticiferous fluid. The *Asclepias syriaca*, which possesses so many latex-vessels in its stem, has very few such in its stock, and none at all in those parts which give off no buds: for instance, the portions contiguous to the aërial stems allow the escape of a coloured fluid; while the remoter parts, together with the roots, give off a scarcely appreciable quantity. I should state, however, that I have sometimes observed a few isolated vessels in the roots. These radical vessels are impregnated with a mucilaginous liquid, of thick consistence and capable of coalescing in little globules of various diameters, themselves sometimes becoming confluent, and apparently being proper juices.

In certain plants the coloured fluids, instead of being less abundant in the roots, accumulate there in a larger quantity than in the aërial portions: thus, in the stem of *Lactuca sativa* the *vasa propria* do not constitute the principal elements of the cortical bundles, which are composed of woody fibres; whilst in the root they almost exclusively form the cortical bundles, into the composition of which few fibres enter. Hence this portion of the plant contains the largest proportion of the laticiferous juices; and on tearing the plant up by the roots, little drops of white fluid are seen to escape from all the torn ends of the fibrils.

As a rule, the *vasa propria* are distinguishable from neighbouring tissues, and particularly from cortical fibres, by the circumstance of their being filled with a granular fluid of some particular colour, and by their flexuous, thin, branching, anastomotic, and isolated form—the fibres being, on the contrary, straight, parallel, closely packed, and often empty. However, in certain plants these proper vessels are straight, very long, with few ramifications, and contain excessively minute granules few in number; on the other hand, cortical fibres occur of very fine calibre, of delicate form, and more or less filled with granular matter, and therefore not so readily distinguishable from *vasa propria*. This happens in *Campanula Medium, C. rapunculoïdes*, and *C. pyramidalis*, in *Euphorbia Lathyris, E. sylvatica*, &c. The distinction is rendered still more difficult when the vessels are articulated. According to Schultz, the articulations are not primary, but are the consequence of age; on this point we shall have something to say hereafter. The reported movements of expansion and contraction we shall also defer, remarking here only that though the difficulties in determining the existence of proper vessels are often great, yet the plan of boiling the parts to be examined, and thereby suddenly destroying vitality and coagulating the proper juices, renders the existence of *vasa propria* in certain parts clearly demonstrable.

XLIV.—*On* Acantholeberis (*Lilljeborg*), *a Genus of Entomostraca new to Great Britain*. By the Rev. ALFRED MERLE NORMAN, M.A.

[Plate XI.]

Fam. Daphniidæ.

Genus ACANTHOLEBERIS (Lilljeborg).

(Syn. *Acanthocercus*, Schödler.)

Anterior antennæ large and conspicuous, porrected from the front of the head. The upper branch of the posterior antennæ four-jointed, and bearing at its termination three plumose setæ and a spine: lower branch three-jointed, and having the first joint provided with a remarkably long-spined seta, the second also furnished with one very long seta, and the last joint terminating in three setæ and a spine. The postero-ventral angle of the carapace is fringed with very long setæ of a spine-like character. Feet five pairs. Intestinal canal simple and straight at first, but furnished with a loop near the anus.

The genus *Acanthocercus* was founded by Schödler, in the 'Archiv für Naturgeschichte' for 1846, for the reception of a remarkable Entomostracan which Müller had described in the 'Zoologia Danica,' under the name of *Daphne curvirostris*. Fitzinger had, however, established a genus of reptiles under the same name three years previously; and Lilljeborg, therefore, in his work on the Entomostraca (De Crustaceis ex ordinibus tribus Cladocera, Ostracoda, et Copepoda in Scaniâ occurrentibus) changed the name of the genus to *Acantholeberis*.

In general characters *Acantholeberis* is closely—perhaps almost too closely—allied to *Macrothrix* (Baird). The resemblance is seen in the general form of the carapace and of the organs of the body, but especially in the large size and position of the anterior antennæ, and in the peculiar and exceptional structure of the long seta of the first joint of the lower branch of the posterior antennæ. The chief differences are to be found in the number of setæ on the upper branch of the posterior antennæ, which in *Macrothrix* are four, but in *Acantholeberis* only three; and in the fact that there is a loop in the intestinal canal of *Acantholeberis* towards the posterior extremity below the point of attachment of the fifth feet; while in *Macrothrix* there is no such fold, the course of the canal being straight.

In 1858, Lievin described a second species of the genus; but